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Coronary Heart Disease

30-Year Experience of 1,160 Men

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FOR SEVERAL years the Division of Human Ecology of Cornell University Medical College has been examining the impact of social mobility and personality upon coronary heart disease among men in a nation-wide industry. These studies have been aimed primarily at examining a theory that has been put forward repeatedly during the last half-century: the theory that the prominence of coronary heart disease in the industrial societies of the Western Hemisphere may be, to some extent, a result of the prominence of social mobility and striving behavior in these societies.[1-6] The occupational experiences of men in these societies had been thought by some to be of special importance in this respect,[4,7] and these have been a focus for our studies. The purpose of this and a succeeding paper is to report upon the 30-year occupational experience of an age cohort of 1,160 men, and the relation of this to the occurrence of coronary heart disease among them. The present paper reports on the methods used, and the findings with regard to coronary heart disease over the 30-year period. The second paper will examine the relation of this to occupational experiences.

General Method

Since atherosclerosis of the coronary arteries undoubtedly develops over a period of many years, beginning, in men, at least as early as the third decade, it seemed reasonable to postulate that occupational experiences, if they are to have a major effect on the development of coronary atherosclerosis, might have to operate over a period of many years also. Although an ideal study might have to extend from adolescence to old age, it seemed reasonable to expect that the effects of occupational experiences over a period of several decades would provide an indication of the magnitude of the effect of these experiences in producing clinical evidence of coronary heart disease. This was a primary reason for undertaking a 30-year study of an age cohort of men.

The cohort was drawn from an ethnically homogeneous industrial population of 260,000 male career employees—blue collar, white collar, and supervisory—who are engaged in a limited number of highly specifiable occupations throughout the nation. This population is stratified into eight levels of organizational responsibility. Its general characteristics and the rationale for its use in an investigation of this sort have been described in a previous paper.[8] It consists of 21,000 men who were college graduates at the time of hire, and 239,000 men who were not. These two groups, which are referred to hereafter as the "college" and the "no college" men, appear to be different in important biological and social characteristics, and seem to be consistently different in the amount of coronary heart disease that they display. Essentially all of the men in this population, regardless of their background, were in their 20's when they were first employed. The rate of attrition among them from all causes is relatively small. Once men have been on the payroll for five years, they tend to remain there until death or retirement. Throughout their careers, they are covered by a sickness-benefit program which provides payment for disability or death. In some segments of the industry there are records which describe the health and occupational

TABLE 1.—*Relation of Age Cohort to National Sample*

	National Sample—1963 260,430 Men Age 20-65 Employed by One Industry in the Continental United States		Age Cohort 1160 Men From One Unit of the Industry (by Highest Level Attained Before Age 60)	
	Background		Background	
Level	College	No-College	College	No-College
Level 3 and higher:				
"Upper managers"	7,836	4,684	131 (106) *	50 (44) *
Level 2: supervisors	6,674	15,909	117 (83) *	146 (127) *
Level 1: foremen	5,157	41,326	14 (1) *	268 (230) *
Level 0: workmen	1,417	177,427	12 (3) *	422 (262) *

* Figures in parentheses represent number of men remaining on active payroll at beginning of study.

TABLE 2.—*Sampling of Survivors on the Payroll Nov 1, 1962 by Background and Level*

	College			No-College		
Level	Survivors on Payroll	20% Sample	Entire Sample	Survivors on Payroll	20% Sample	Entire Sample
Level 3 and higher:						
"Upper managers"	106	23	51	44	10	44
Level 2: supervisors	83	17	51	127	24	50
Level 1: foremen	1	0	0	230	47	57
Level 0: workmen	3	0	0	262	56	103
Total	193	40	102	663	137	254
Grand totals:	Survivors on payroll at the beginning of the study			856		
	20% sample			177		
	Entire sample			356		

experiences of individual men throughout their entire working careers.

At the time that this study was initiated, it was not possible to obtain an age cohort of men designated at random from the nation-wide industrial population as a whole. Therefore, an age cohort was selected from one unit of the industry. This company was chosen after it had been ascertained that it was near the median of all companies in the industry with regard to size, with regard to rural-urban distribution of its activities, and with regard to the composition of its workforce in terms of level, categories of employment, and age. It was also determined that the company possessed the necessary records of its employees covering their working careers.

The unit chosen is in the middle range of size in the industry, ranking 11th out of 23 in the number of its employees. Its geographical location is in the middle Atlantic states. Its operations cover rural, urban, and metropolitan areas in roughly equal proportions. The 10,000 men on its payroll are divided into occupational categories parallel to, and essentially identical with, those in the other units of the industry. The proportion of managers and nonmanagers is within three percentage points of the mean for the industry as a whole, and the proportion of college graduates in various occupational categories and at various levels of management is not significantly different from the proportion found in the other units. In 1960, the reported rate for disabling events of arteriosclerotic heart disease

under Rubric 420 of the International Classification of Disease for all men in this unit was 4.20 per thousand—a rate not significantly different from the rate throughout the industry.

It was possible to obtain data on an age cohort of men from this company whose members had had at least 30 years of employment experience over the same period of time. Since it was known that the attrition rate among these male employees had been highest in the first five years of their employment, it was decided that the cohort for study should be designated from men who had already been on the payroll for at least five years, the purpose being to minimize subsequent attrition from causes other than death. It was possible to do this, while at the same time selecting a cohort whose members were at a median age of 30 years—an age at which it could be expected that few or none of them would already have experienced a disabling event of overt coronary heart disease. In this way, one could be assured that essentially every man in the cohort would be "at risk" from the point of view of new disabling coronary heart disease. Although clinically undetectable atherosclerotic processes were undoubtedly present in the arteries of many of these men by age 30, one could nevertheless examine the relation between many years of subsequent employment experience and the occurrence of clinically overt disease within the group.

The cohort was selected by obtaining a complete payroll of the company for Jan 1, 1935, and then designating all of those men on the list who had

TABLE 3.—*Definite and Probable Myocardial Infarction*

Background and Level	Men Examined Completely			Men Not Examined Completely		
	No.	Men With Myocardial Infarction	Rate per 100	No.	Men With Myocardial Infarction	Rate per 100
College						
Level 3 and higher Upper managers	49	2	4.1	2	0	0.0
Level 2 Supervisors	44	1	2.4	7	0	0.0
No college Level 3 and higher Upper managers	41	3	7.3	3	1	33.3
Level 2 Supervisors	42	0	0.0	8	1	12.5
Level 1 Foremen	46	3	6.5	11	1	9.1
Level 0 Workmen	79	6	7.6	24	3	12.5
Total	301	15	5.0	55	6	10.9

been born between Jan 1, 1902, and Dec 31, 1908, and who had been hired between Jan 1, 1923, and Dec 31, 1930. Eleven hundred sixty men were designated by this procedure. Of these, 274 had had college degrees when hired, and 886 had not.

The 30-year experience of these men was traced by various means. Since the great bulk of them had remained on the payroll of this company, had retired from this company, or had been transferred to other companies within the industry, the industrial records provided an immediate means of determining their present status, as well as their employment history. The company possessed similar information on all those who had died while on the active payroll, and on all of those who had died after retirement. A total of 1,066 men were located from the company records.

Ninety-four of the men in the cohort, or 8.1% of the total, had resigned or had been dismissed at some time between Jan 1, 1935, and Jan 1, 1965. Most of these resignations or dismissals occurred in the period between 1935 and 1940. It was possible to obtain the Social Security numbers of 61 of these men. These were submitted to the Division of Claims Policy of the Social Security Administration, which supplied us with data on all of those for whom death claims had been filed, including the date and place of filing. Of the remaining 33 men, all except eight (six "no college" men and two "college" men) were located by information obtained from telephone directories, from college Alumni Associations, and from friends and relatives.

Of the 1,152 men whose status on Jan 1, 1965, was ascertained, 166 had died. Copies of the death certificates for all of these men were obtained. Extensive company medical records were still available for 40 of them, and it was possible to compare these with the data on the death certifi-

cates. We discovered no instance in which the company record indicated a substantial reason to doubt the accuracy of the death certificate. In many instances, the final fatal illness was described in the company record. In other instances, the records, so far as they went, supported the final diagnosis. For example, in a number of instances in which men were reported to have died suddenly from "coronary occlusion," although the company records contained no direct data relating to the final illness, they did describe and document the previous presence of hypertension, which often had been accompanied by some electrocardiographic abnormalities or by a history of chest pain.

Procedures

In order to determine the prevalence of coronary heart disease among the men who had had 30 years of employment experience, and who still survived and were on the payroll, 301 men from the age cohort were examined completely, as follows:

Sampling.—On Nov 1, 1962, when the study of the cohort began, 856 men were still on the payroll of the original company. From these 856 men, two random samples, stratified by "college"—"no college" background and by level of management, were obtained. First, a 20% sample was obtained from the "no college" men at level 0, level 1, level 2, and levels 3, and above; and from the "college" men at level 2, and at levels 3, and above. Three "college" men at level 0 and one "college" man at level 1, who represented all of the "college" survivors still on the payroll at these levels, were not sampled. This sample contained a total of 177 men and has been utilized for analyses which require that all strata be sampled in equal proportions.

Because this 20% random sample contained only

	Entire Sample	
No.	Men With Myocardial Infarction	Rate per 100
51	2	3.9
51	1	2.0
44	4	9.1
50	1	2.0
57	4	7.0
103	9	8.7
356	21	5.9

a small number of men from some strata, after it had been drawn, additional men within each stratum were designated at random, until a total of at least 50 men had been obtained from each of the management strata, and 103 men had been designated from the level 0 workmen of "no college" background. The total of the men in this sample was 356. It has been used for analyses which do not require that the strata be sampled in exactly equal proportions. Many of the computations in this report were based upon the larger sample with appropriate adjustments for disproportionate sampling of the various strata. The relation between the original cohort, the survivors on the payroll, and the two samples is shown in Tables 1 and 2.

Method of Examination.—Each of the men designated by this sampling procedure was asked to volunteer for an examination. A total of 301 of the 356 agreed to do so and were examined completely in the following manner.

Each man first filled out a Medical History Questionnaire. This form provides for a systematic review of the past medical history and the present symptoms of disease and gives specific attention to the symptoms and signs of cardiovascular disease. It also asks for detailed information about the daily round of life, the smoking habits, and the medications taken by the subject, and some information about his diet and pertinent familial illnesses. A cardiologist then reviewed the questionnaire in detail with the subject. Upon completion of his history-taking and examination, the cardiologist made a graded evaluation of some of the features of the cardiovascular history of the subject, especially his history of previous myocardial infarction, or coronary insufficiency, or of angina pectoris. In making this evaluation, he followed the criteria recommended by the Conference on Epidemiology

of Cardiovascular Diseases Methodology,[9] and he entered his judgment in a coding form.

The physical examination followed a pretested Physical Examination Form. All items were completed by the examiners. They paid particular attention to phenomena such as the presence or absence of tophi, arcus senilis, xanthelasmata, eyeground changes (which were graded according to the Keith-Wagoner scale for arteriosclerosis),[10] and the pulses in the peripheral vessels. The blood pressure was taken two times in each arm, at the beginning and the end of the examination, with the subject in a sitting position, using a 12-cm cuff and a mercury manometer. The diastolic level was recorded both when the sound changed and when the sound ended. The cardiovascular examination followed the general form that has been used in the Framingham survey.[11] Cardiac murmurs, when detected, were described and graded by two observers.

In addition to the physical examination, each subject received a six-foot PA chest x-ray, which was read independently by two roentgenologists, using a standard form. This form provides for standard measurements of cardiothoracic ratio, calcification and tortuosity of the aorta, and chamber enlargement of the heart. In the morning, when the subject was in the rested, fasting state without having smoked for eight hours, a standard 12-lead electrocardiogram was obtained. This was read independently by two electrocardiographers who had no knowledge of the clinical findings. In the case of conflicting readings of measurements, a reading from a third cardiologist was obtained. Measurements and manifestations were coded and recorded after the manner suggested by Blackburn,[12] using a standard coding form. While the subject was fasting, samples of his venous blood were obtained also, and were examined for ABO blood groups, hematocrit, RBC, WBC, and differential. A serological test for syphilis was carried out. Serum samples were examined for cholesterol (method of Abell),[13] triglycerides (method of Van Handel and Zilversmit),[14] and nonesterified fatty acids (method of Dole)[15]; and they are now being examined for uric acid concentration (method of

TABLE 4.—*Status of Men in Cohort After Thirty Years: Jan 1, 1965* *

	Living Jan 1, 1965	Died Before Jan 1, 1965	Death Rate per 1,000
On payroll, this company	790	136	146.9
Transferred to other companies	33	2	57.1
Retired	90	15	142.9
Resigned after Jan 1, 1935	48	8	142.9
Dismissed after Jan 1, 1935	25	5	166.7
Totals	986	166	144.2

* Present status known, 1,152
 Not accounted for, 8
 Original cohort, 1,160

TABLE 5.—*Deaths Occurring Among 1,152 Men Between Age 30 and Age 60 by Cause*

	Deaths	Rate per 1,000
1. Coronary occlusion and myocardial infarction, so specified	65	56.4
2. Other heart disease	15	13.0
3. Vascular disease	15	13.0
4. Neoplasia	36	31.3
5. Infection	13	11.3
6. "Suicide"	6	5.2
7. Accidents	6	5.2
8. Various other conditions	10	8.6
Totals	166	144.2

TABLE 6.—*Deaths Among Men on Payroll at Time of Death, and Among Men Previously Transferred, Retired, Resigned, or Dismissed*

	On Payroll		Not on Payroll	
	Deaths	Rate per 1,000	Deaths	Rate per 1,000
Total deaths	136	146.9	30	132.7
Coronary deaths	54	58.3	11	48.7

TABLE 7.—*Prevalence of Coronary Heart Disease Among 856 Survivors on Payroll at Beginning of Study, Nov 1, 1962*

Manifestation	Rate per 100 (Adjusted for Sampling Proportions)
1. Previous myocardial infarction	
"Definite" by history and record	4.5
"Probable" by history and record	1.5
ECG evidence only	2.1
2. Angina pectoris, typical by history	3.4
3. Coronary insufficiency by history and record	3.3
Total of above	14.8 (10-20) *
4. ST and T abnormalities on ECG, otherwise unexplained	6.3 (3-10) *

* Approximate 95% Confidence Limits

Dubbs et al).[16] Later in the day, two hours after a high carbohydrate meal that included 12 oz of carbonated drink, a urine sample was obtained and was examined for specific gravity, protein, pH, and formed elements.

If the history, the examination, or any of the laboratory procedures yielded evidence of a condition thought to be relevant to this study, an attempt was made to obtain records and other pertinent data from hospitals, private physicians, and the company medical department. Sometimes other diagnostic procedures were carried out, by arrangement.

Criteria for Coronary Heart Disease.—Five criteria for evidence of the presence of clinical coronary heart disease were used in this study:

1. The previous occurrence of a *definite myo-cardial infarction,* as defined by the Conference on Epidemiology of Cardiovascular Diseases Methodology.[9] Those who were considered to meet this criterion were men who had had episodes characterized by typical symptoms, signs, and course; electrocardiographic changes typical of the evolution of an acute infarct; and enzyme changes, fever, and leukocytosis indicating muscle damage. The data supporting this had to be available to us.

2. The presence of a *probable myocardial infarction.* In this category were men who had had episodes whose symptoms and signs were somewhat less typical, or laboratory findings less complete, or both, and men whose physicians' or hospital records stated flatly that they had had myocardial infarctions in the past, but who could not produce records or electrocardiographic tracings to substantiate this. In all of these instances, the cardiologists on our staff, on evaluating the evidence, including the results of our examinations, concluded that (*a*) the man had definite findings pointing to coronary heart disease, and (*b*) he had probably had a myocardial infarction in the past.

3. The presence of *definite angina pectoris.* Every instance of chest pain reported by these men was inquired into in detail by the Medical History Questionnaire and by the examining physicians; and the physicians were asked to grade each history of chest pain according to their clinical judgment into one of four categories: (*a*) typical angina pectoris; (*b*) probable angina pectoris; (*c*) possible angina pectoris; and (*d*) probably not angina pectoris. *Typical angina pectoris* was defined as "a discomfort or pain, occurring across both sides of the anterior chest wall or located centrally in the sternal region, brought on by effort, eg, exercise, emotion, exposure to cold and wind. It may radiate to the left arm, or both arms, the shoulders, the neck or the jaw. It is spontaneously described as 'pressing,' 'tight,' 'heavy,' 'constricting' or 'crushing,' or as 'numbing' or 'burning.' It is usually relieved within a few minutes after cessation of effort or of taking sublingual nitroglycerine."[9]

4. The presence of *coronary insufficiency.* (This category corresponds to the category designated by the Conference on Epidemiology of Cardiovascular Diseases Methodology as "Possible Myocardial Infarction.") This was defined as an episode of pain having the quality and characteristics of the pain seen in angina pectoris or myocardial infarction, but lasting longer than angina pectoris, and not being relieved within a few minutes by rest or nitroglycerine. This pain was not accompanied by evidence of vasomotor collapse, or by any laboratory evidence of myocardial damage; and electrocardiographic changes, if present, were transitory and limited to changes in the ST segments or T waves of the type commonly regarded as indicative of myocardial ischemia.

5. The presence of *electrocardiographic evidence of previous myocardial infarction* in the absence of any history or suggestive symptoms or signs. In this category, only QRS changes, as recommended by

TABLE 8.—*30 Year Death Rate From Cardiovascular Disease Among 1,152 Men in the Age Cohort*

	880 No-College Men		272 College Men	
	Deaths	Rate per 1,000	Deaths	Rate per 1,000
Acute myocardial infarction	55	62.5	10	36.8
Other heart disease:				
Rheumatic heart disease	6		0	
Cor pulmonale	1		1	
Congestive heart failure cause not specified	5		0	
Acute myocarditis	1		0	
Idiopathis pericarditis	0		1	
Totals	13	14.8	2	7.4
Vascular disease				
Stroke	6		2	
Malignant hypertension	2		0	
Ruptured aortic aneurysm	0		2	
Subarachnoid hemorrhage	2		0	
Totals	10	11.4	4	14.7
Total cardiovascular disease other than myocardial infarction	23	26.1	6	22.1

Blackburn [12] and by the Conference on Epidemiology of Cardiovascular Diseases Methodology,[9] were accepted.

All of the men categorized as having coronary heart disease may be regarded as displaying rather "hard" evidence of this disease. Excluded from this category were a number of men whose evidence of coronary heart disease consisted of histories of chest pain considered to be "probable angina pectoris," and men with ST and T wave changes of a type that many cardiologists have considered to be evidence of coronary heart disease when they occur in middle-aged men.

Estimates of Sampling Bias

Since only 301 of the 356 men in the designated sample were actually examined, it was important to estimate how much bias may have been introduced by differences in response rates of the men in the various strata. For all of the men in the designated sample attendance records and company medical records covering the period from Jan 1, 1935, to the present were available. In addition, for about one half of the 55 men who were not examined by us, there were available the results of other examinations, questionnaires, and physicians' and hospital records, which were extensive though not complete. All of these were men who had been reported to be ill in some way at some time in the past. The others had never been reported to the company to be ill, and had had no period of sickness-absence that might have represented a myocardial infarction. For all of the men in the designated sample, we were able to determine:

1. Whether or not they had ever been reported to have myocardial infarctions or other evidence of coronary heart disease; and, if they had, to have many details of the reported episodes;

2. Whether or not they had had any sickness-absence during their period of employment; and, if they had, its duration, reported cause, and often many details about it.

Using these data, we could compare the occurrence of definite and probable myocardial infarction among the men who were examined completely with the occurrence in men who were not examined. The rate for definite and probable myocardial infarction was 5.0 per hundred in the 301 men examined completely, and 10.9 per hundred in the 55 not examined completely (Table 3). The total number of definite and probable myocardial infarctions among all the men in the initial sample of 356 was used as a basis for estimating the prevalence of these phenomena among the 856 survivors. The relative ranks of the various strata given by the combined data from the two sources were quite similar to the ranks based only on definite coronary heart disease in the men examined completely. This suggested that very little interstratum bias had been introduced by inability to examine completely 15.4% of the men in the sample, despite

TABLE 9.—*30 Year Death Rate From Causes Other Than Cardiovascular Disease Among 1,152 Men in the Age Cohort*

	880 No-College Men		272 College Men	
	Deaths	Rate	Deaths	Rate
Neoplasia	27	30.6	9	33.1
Infection	11	12.5	3	11.0
Suicide	5	5.7	1	3.7
Accident	3	3.4	3	11.0
All other causes	10	11.4	0	0.0
Totals	56	63.6	16	58.8

TABLE 10.—*Prevalence of Coronary Heart Disease Among 856 Survivors on Payroll, Jan 1, 1962, by Background and Level*

	No-College Rate per 100	College Rate per 100
Level 3 and higher		
Upper managers	16.4	12.1
Level 2		
Supervisors	6.8	6.5
Level 1		
Foremen	20.0	—
Level 0		
Workmen	17.6	—
Totals	16.3	9.4
(adjusted for sample		
proportions)	(11-21) *	(6-13) *

* Approximate 95% Confidence Limits

the fact that some underreporting of coronary heart disease may have resulted from this.

Results

Status of the Men in the Cohort on Jan 1, 1965.

The status of these men on Jan 1, 1965, is shown in Table 4. Those remaining on the payroll 30 years after the date of designation numbered 790, or 68.1% of the original cohort. Their median age was 60 years at this time. The biggest single cause of attrition in the group during the intervening years was the death of men on the active payroll. Most of the retirements had occurred among men past the age of 55; the bulk of them were among men age 60 or older. Most of those transferred to other companies in the industry had remained on the active payroll. Only 8.1% of the original cohort had dropped out of the industry entirely. These findings were in accord with the evidence from other sources which indicated that the nation-wide industry experiences relatively little attrition among men between the ages of 30 and 60 for causes other than death.

The Thirty-Year Experience: Death by Cause.

Of the 1,152 men whose status on Jan 1, 1965 was ascertained, 166 had died, yielding an overall death rate of 144.2 per thousand for the 30-year period. The death rates for the men who had retired, resigned, or had been dismissed were comparable to the death rates of those who had remained on the payroll of the company (Table 4).

The most frequent single cause of death among the men in this cohort in the years from ages 30 to 60 was "coronary occlusion" or "myocardial infarction," so specified on the death certificate. This accounted for 65 deaths with a rate of 56.4 per thousand (Table 5). The rate for cardiovascular disease was 82.5 per thousand for the 30 years. Various forms of cardiovascular disease accounted for more than half of the deaths in the cohort.

Neoplasia was the second most frequent cause of death. Various infectious processes, some localized or secondary to injuries, accounted for 14 deaths, predominantly in the younger age ranges. Suicide and accident were relatively frequent causes of death in the younger ages, also.

The coronary heart disease death rate for men who had been separated from the payroll for various reasons was essentially the same as the rate for the men who had remained on the payroll (Table 6).

The Prevalence of Coronary Heart Disease Among the Survivors Still on the Payroll.

After an appropriate adjustment for sampling proportions, the prevalence of overt coronary heart disease among the 856 survivors who were on the payroll when the sample was drawn was estimated at 14.8 per hundred (Table 7). Since the cohort had already lost 5.6 men per hundred from coronary heart disease before the sample was drawn, the 30-year prevalence of overt coronary heart disease during the period between ages 30 and 60 may be estimated at 20.4 per hundred. In effect, one man in five developed definite evidence of coronary heart disease during this time.

Among the survivors, there were an additional 6.3 men per hundred who exhibited

TABLE 11.—*Coronary Deaths by Age*

Age	Men at Risk	Total Deaths	Annual Rate/1,000	Coronary Deaths Expected *	Coronary Deaths Observed	Annual Rate/1,000
29-39	1,152	25	2.1	2.4	4	0.35
40-44	1,127	20	3.5	5.3	6	1.06
45-49	1,107	26	4.7	13.6	7	1.26
50-54	1,081	39	7.2	24.4	22	4.07
55-59	1,042	49	9.4	38.3	21	4.03

* Based on contemporary coronary death rates for white men, United States, of similar age.

(N.B. Five men who died of coronary heart disease before Jan 1, 1965, but after the age of 59, are not included in this table.)

definite ST and T wave abnormalities of a "non-specific" nature in their ECGs. It is a reasonable assumption that these abnormalities were the result of coronary heart disease in a great many instances. If one adds these men to the men who had experienced various forms of definite coronary heart disease, the estimated prevalence rate for "definite" and "suspect" coronary heart disease among the survivors is approximately 27 men per hundred. Thus, by age 60, overt or suspect coronary heart disease had affected one man out of four in this cohort. By contrast, the number of men in the cohort at the age of 60 who were entirely free from symptoms or signs suggesting coronary heart disease, and free also from all clinical or laboratory signs of atherosclerosis, hypertension, diabetes mellitus, gout, and obesity, was estimated to be 2.7 per hundred.

These prevalence rates for coronary heart disease among the survivors at age 60, though high, are not greatly different from those reported from Framingham, Mass,[17] from Tecumseh, Mich,[18] and from the Chicago utility studied by Stamler.[19]

Deaths Among "College" and "No College" Men.—The preliminary results of the nation-wide survey have suggested that the "college" and "no college" groups may be two distinct populations in relation to their risk of coronary heart disease. In Tables 8 and 9, deaths, causes of death, and background of the men who died are tabulated in more detail. In the cohort, acute myocardial infarctions were almost twice as frequent among the "no college" men as among the "college" men. This difference is not statistically significant, but the direction of the difference is in accord with the

evidence from the nation-wide survey. All other causes of death were approximately equally distributed between the two groups. The over-all 30-year death rate was higher among the "no college" men, but the difference was accounted for almost entirely by the difference in deaths due to myocardial infarction.

Prevalence of Coronary Heart Disease in "College" and "No College" Men.—The prevalence of coronary heart disease among the survivors still on the payroll is shown by background and level in Table 10. The difference between the overall prevalence of 9.4 per hundred for definite coronary heart disease among the "college" survivors and 16.3 per hundred among the "no college" survivors also is not statistically significant, but the direction of this difference is in accord with the death data, and also with the data from the national survey.

Coronary Deaths by Age.—The age specific death rates for the cohort are shown in Table 11. The deaths observed have been compared with the number of deaths "expected" by calculating these from the appropriate age specific death rates from coronary heart disease (Rubric 94 prior to the Sixth Revision; Rubric 420 after the Sixth Revision of the International Classification of Diseases) for white men of the same age and the same decade, from data provided by the US Bureau of Vital Statistics.[20] (For example, the number of deaths expected in the cohort from age 30 to 34 was calculated from the national death rate for white men of this age in 1938, when the members of the cohort were of median age 33, and so on.) The number of coronary deaths observed in the cohort

appears to be somewhat smaller than the number that would have been expected for American white males as a whole.

Comment

The findings of this study lend support to the evidence from other sources which has indicated that the male population of this industry is relatively stable between the ages of 30 and 60. They suggest that the dismissal, resignation, or retirement of a rather small proportion of men between these ages does not create a significant bias in the distribution of coronary heart disease among the men remaining in the group. The results also support the information from the national sample which indicates that the incidence of coronary heart disease in the men in this industry is of the same order of magnitude as that for all white men in the United States, although perhaps slightly lower. The finding that one man in four develops overt clinical evidence of this disease before the age of 60 provides a rather striking example of the importance of this disease among regularly employed American men in middle life.

The death data and the prevalence data from this cohort do not contradict the concept that coronary heart disease occurs more frequently among the men in this industry who are of "no college" origin than among the men who are of "college" origin. Up to now, this has been consistently suggested by the data derived from the industry as a whole. It, in turn, suggests that some of the important determinants of the later occurrence of coronary heart disease in these men had already been established before they were hired in their early 20's. This point will be considered further in later papers.

Summary and Conclusions

An age cohort of 1,160 men from one unit of an industry has been studied over a period of 30 years between the ages of 30 and 60. The deaths from coronary heart disease among the members of this cohort, and the prevalence of the manifestations of coronary heart disease among the survivors at age 60 have been examined.

The status of all but eight of the men in this cohort at the end of the 30-year period has been established. Only 8.1% of them were lost from the group because of resignation or dismissal; and only 35 have retired during the period covered by the study. The death rates among those dismissed, resigned, and retired were comparable to the death rates among the men who had remained on the payroll.

The 30-year coronary death rate for the whole cohort was 5.6 per hundred. Among the survivors still on the payroll at age 60, 14.6 per hundred exhibited definite evidence of coronary heart disease. These rates are comparable to those for white American men of the same age range throughout the nation.

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DIVISION OF LABOR

During the long hunting phase of human existence a third division of labor, based on differences in occupation, began to appear, to a certain extent in toolmaking, but more in the arts of healing and of dealing with disturbances in human relations caused by changes in the weather. This segmentation was not great enough to affect the basic structure of human groups. Hunters lived in bands of from two to twenty or so families, all usually related to one another. In each band, while families were independent, the leadership was vested in one man in his prime, distinguished for his skill at providing meat, in preventing and settling quarrels, and in conducting foreign affairs with the leaders of other bands occupying neighboring hunting territories.

In such a band everyone knew everyone else and protocol was simple. Over the hundreds of thousands of years that man lived as a hunter he perfected his capacity to be intimate with the members of his band, and formal with outsiders. Young men learned ways of behaving toward women, children, and old people which would make life easiest for all concerned, and hence would enhance the survival value of the band as a whole.

As man progressively conquered the forces of nature, and as a division of labor on the basis of work techniques increased, more and more people were brought into mutual contact. For each type of organization that arose in addition to those of family and band, some kind of leadership, and a pattern of orderly behavior, created themselves. The shop of smiths, the crew of a boat, the members of a trading expedition, a war party, all had to have structure, with a leader, followers, and rules of procedure. As these institutions grew in size and numbers, they also grew increasingly formal. While it is easy for members of a small intimate band to get along together on a personal informal basis of natural give and take, when people belong to different families and different face-to-face groups, such as neighborhoods or sections of a village, trouble can arise if rules are not formulated and observed. This is still true because human beings are still biologically hunters. Each of us has his group of intimates among whom he can relax, and he deals with other people in a more formal manner.—Coon, C.S.: *The Story of Man—From the First Human to Primitive Culture and Beyond,* ed 2, New York: Alfred A Knopf, Inc., 1962, pp 6-7.